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METHODOLOGY FOR ESTIMATING SELECTED SOVIET MILITARY EXPENDITURES

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Methodology for Estimating Selected Soviet Military Expenditures1. Subsistence (Food) for Military Personnel on Active Dutya. Ruble Values

The determination of the outlays for food by the Soviet Ministry of Defense for its military personnel is reduced to a rather simple formula that is believed to produce rather sound results. The procedure employed is the pricing of the basic Soviet military ration.*

A circular of the Quartermaster General of the Armed Forces of the USSR that was issued in 1949 provided the details of the basic ration. 1/ Other sources confirm that the prescribed ration is approximated in practice and that it has undergone little or no change. 2/ That circular is sufficiently detailed in that it includes "norms" for both quantity and quality, for the amounts of "foodstuff [to be] placed in kettle per man per day," and for the "waste [to be expected] in processing foodstuffs [before cooking]."

Table 1** presents this basic military ration in the USSR in terms of weekly requirements per capita. The prices applied to the specified quantities represent average annual Moscow prices for purchases at wholesale rates. Hence the turnover tax is included, but retail trading margins have been eliminated.

The resulting required outlays for a weekly ration per capita are converted to an annual outlay per capita which is, in turn, applied to the total regular service manpower on active duty. Clearly this method is not realistic, first, because it is known that there are several military rations, the one used being the least costly,*** and, second, because officers and also re-enlistees receive a subsistence allowance reported as 200 rubles per month.† Thus the Ministry of Defense is presumably bearing a subsistence cost of 2,400 rubles per year for each officer, whereas the basic ration for enlisted men imposes a burden some 30 percent higher‡ on a per capita basis.

Other considerations may also affect the magnitude of the derived results: for example, military farming operations and military processing facilities. In addition, the prices paid for those subsistence items procured locally by military units stationed outside of the USSR may also have some bearing on the results. In view of the number of these troops, however, and their apparent dependence on fairly substantial imports of foodstuffs from the USSR, §/ it does not seem likely, even though local purchases may be made at favorable prices relative to those paid in the USSR, that any substantial error is likely to accrue from failing to account specifically for such local purchases by occupation forces.

In summary, the effects of these unaccounted for influences are counterbalancing, at least to some extent. At this time it is not possible even to measure the relative significance of such practices as military farming and processing. It might be noted, however, that the present subjective evaluation of the ruble estimates of the Soviet subsistence bill is that they are reasonably accurate.

Moreover, no distortion is believed to be introduced through conversion to other price bases by means of indexes. The index employed reflects retail price movements, ¶¶ 10/ but in view of the relative stability of retail

* Thus only current needs are taken into account. Reserves of food for the military establishment may be part of the Soviet stockpiling program and not an expenditure of the Ministry of Defense.

** Table 1 follows on p. 2.

*** Substantially so, according to one source, §/ which cites a cost of 324 rubles per month per person for the universal military ration and 941 rubles per month per person for the ration issued to flying personnel. The cost of other military rations lies somewhere between these extremes.

† Those stationed in East Germany, however, do not receive a monetary allowance.

‡ Relative to ration costs during the period 1955-58. In 1951 prices the enlisted man's ration is 67 percent more costly if the costs borne by the Ministry of Defense have remained unchanged.

¶¶ The value of the index for 1955 (1951 = 100) is 78.

Table 1

Cost of the Basic Military Ration in the USSR a/

Item	Net Ration (Gross per Week)	Waste (Percent of Gross Ration)	Gross Ration (Gross per Week)	Procurement Price b/ (1951 Rubles per Kilogram)	Cost of Ration (1951 Rubles per Week) c/
Meat	900	25	1,200	20.0	24.0
Fish	600	35	923	12.5	11.5
Fats (animal and vegetable)	350		350	25.2	8.8
Cereals (including macaroni)	1,165		1,165	5.5	6.4
Flour	140		140	4.1	0.6
Potatoes	3,500	25	4,666	0.76	3.5
Vegetables	2,880	15	3,402	1.8	6.8
Condiments	20		20	12.8 d/	0.3
Bread	6,300		6,300	1.96	12.3
Sugar	250		250	11.4	2.8
Tea	7		7	132.4 e/	0.9
Salt	210		210	0.5 f/	0.1
Tobacco	70 g/		70	14.4 h/	1.0
Total					71.0

- a. Unless otherwise indicated, physical quantities and wastage factors are based on a circular of the Soviet Quartermaster General. b/
- b. Retail prices 5/ discounted by trading margins. g/
- c. The index used to represent these costs on other price bases is essentially the Soviet index of state retail food prices.
- d. The price of condiments is assumed to approximate the prices of canned goods.
- e. Retail price.
- f. The 1951 price is an estimate based on 1948 and 1953 prices.
- g. 7/
- h. 8/

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trading margins, the index should also be a reasonable representation of wholesale price movements.* Nor should it matter that this index is being applied to a sample somewhat less comprehensive in its coverage, for the composition of the sample is not believed to differ excessively from that underlying the index.

b. Dollar Values

Dollar equivalents can be obtained on two entirely different bases: the outlay per capita for rations for the US armed forces, or the required outlay for the Soviet ration. In practice, only the former basis is in use. It is employed to reflect the outlays that would be necessary in the US to support Soviet military manpower. Both a conceptual and a practical reason exist for this selection: first, subsistence outlays are viewed as part of the "cost" of a man and, second, monetary allowances, as opposed to payments in kind, play a large part in the total of such US military expenditures.

In theory, determination of US outlays for subsistence is extremely simple. A breakdown of the monetary allowances for all those receiving them, by rank and grade, plus the outlays for subsistence received in kind, would provide the necessary information. Such detail, however, has not as yet been incorporated into calculations of dollar equivalents. Rather, published aggregates of US expenditures for subsistence ^{11/} plus an increment** deducted from published aggregates of pay and allowances have been the basis for determining an average outlay per capita for US military personnel. Application of this figure to the figure for Soviet military manpower yields a dollar equivalent of the cost of subsistence for such forces in the US. Obviously a drawback inherent in this practice is the failure to account for differences in the composition of military forces. In addition, it is probable that US outlays labeled as being for subsistence in some years do not represent consumption but a net outlay resulting from an algebraic summation with reserves or stockpiles. This factor may be minimized, however, given the availability of a figure for the daily cost of rations per person*** for those using service mess facilities, which permits a test of the reasonableness of the information already cited.

The second method of computing the dollar equivalent of Soviet subsistence outlays is a repetition of the exercise followed in obtaining ruble values, except that appropriate dollar prices are substituted. The prices would be those actually paid by the US quartermaster organizations. ^{12/} It may be noted that these prices approximate closely the usual wholesale prices in major US markets.

c. Ruble-Dollar Ratios

Ruble-dollar ratios based on either of the dollar valuations are easily derived. On a strictly practical basis, however, there is little point in deriving the relationship between outlays per capita of the USSR in rubles and of the US in dollars.† Ratios based on ruble and dollar valuations of the respective rations of the two countries, however, would serve their purpose in the context of national accounts and similar studies. Clearly, there is no

* Should the Soviet military establishment be procuring subsistence items at special prices or at relatively primary processing stages, the applicability of the cited index is subject to further question. Because special prices may or may not follow a pattern like that of wholesale and/or retail prices -- depending on the relationship between the former and latter, if any -- it is not possible to evaluate their effect. Something can be said, however, with regard to possible military purchases of foodstuffs at more primary stages because the military establishment possesses some processing facilities. In such instances the movement of prices is not likely to follow the pattern of wholesale prices but to come closer to agricultural procurement prices, which have followed an entirely different pattern. Thus the charges for handling and processing as well as elements of the turnover tax are bypassed.

** To account for subsistence allowances.

*** About \$1.10 per person per day.

† About 7.8 rubles per dollar of expenditure in terms of 1955 relationships.

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problem in obtaining such a ratio with Soviet weights, assuming acceptance of the valuations already discussed, but some question exists with regard to a ratio with US weights, primarily because of the apparent diversity of rations and the widespread payment of monetary allowances in the US. Nevertheless, there is available a US ration list which serves as a guide for planning and preparation and presumably is sufficiently representative.^{13/} Of course, that share of subsistence paid for in allowances is not included.*

d. Further Considerations

The foregoing discussion illustrates, at least implicitly, the type of data necessary for further refinement and an improved confidence level. Aspects of the general problem of Soviet pricing policy are pertinent at least with regard to more positive verification that some of the factors do not have any bearing on this subject. Then, too, there is the problem of the extent of the applicability of Moscow-based prices, particularly where there is a substantial amount of local procurement (whether it is internal or external to the USSR). Furthermore, it would be desirable if the other Soviet rations known to be in use were included in this calculation.

Dollar valuations, if greater effort is to be expended on counter-part costs, should be improved by recourse to such detail as the breakdown by rank and grade of those receiving allowances instead of rations and of those receiving rations in the US armed forces.

2. Clothing for Military Personnel on Active Duty**

a. Ruble Values

25X1X7

The estimates for individual clothing issues, which were obtained from reports from the [redacted] and the RAND Corporation, ^{14/} were derived in like fashion: a clothing issue priced by the item. There was some variation between the items of issue, however, as there were differences in the prices applied. Nevertheless, the resulting outlays per capita, as estimated, were surprisingly close. The estimate in the [redacted] report for 1953 was 3,720 25X1X7 1953 rubles; that from the RAND Corporation report, 2,700 1951 rubles for 1951. On an annual basis, both sources cite, without further adjustment, 900 rubles 25X1X7 per man. Accounting for this apparent anomaly is the assumed life of the clothing: 4 years, according to the [redacted] report, and 3 years, according to the RAND Corporation report. With adjustment for repairs and changes in price, the [redacted] 25X1X7 report gave a prorated annual outlay per capita of 1,100 rubles in 1951. Presumably the RAND Corporation estimate would also rise above the level of 900 rubles if the costs of repairs and maintenance were taken into account. Thus these two estimates, their differences notwithstanding, are roughly 1,000 1951 rubles per year. This figure has been embodied in the studies of military expenditures by this Office.^{***}

There are, besides those problems already mentioned, a number of problems that are related to this subject and that warrant consideration. In 25X1X7 formulating these estimates, it was found necessary in both the [redacted] and RAND Corporation reports to rely on the Soviet retail price structure. In the [redacted] 25X1X7

* Within the sphere of national accounts this leads to a somewhat peculiar dichotomy: where subsistence is represented by a monetary allowance, it becomes an element in the valuation of military services; where subsistence is provided in kind, it is not so treated.

** Excluding special clothing, such as flight gear, which is considered organizational equipment.

*** It will be noted that the resulting estimate more realistically represents average annual outlays; the procedure employed is not responsive to the irregular expenditures that would be incurred, for example, by a major change in the basis clothing issue.

In order to convert this value to the monetary relationships of other years, the published Soviet retail price index for items other than food is used whenever it is available. Since 1954 this index has remained essentially stable.

report, scattered, published retail price data were applied to the items of the issue, whereas in the RAND Corporation report, prices paid by the Soviet military establishment in 1940 were used and a retail price index was applied to the results in order to achieve a 1951 price base.

In addition to the problem of prices, there are problems relating to the makeup and the applicability of the standard issue of clothing. It is apparent that two somewhat different issues of clothing lay behind the estimates contained in the [redacted] and the RAND Corporation reports. Even though the composition of the issue used in the RAND Corporation report is based on information from a Soviet handbook, 15/ the publication dates back to 1947, and some changes are known to have occurred since that time. 16/

Furthermore, the clothing issue is treated as being applicable for all ranks and grades. It is more likely that re-enlistees and officers receive an issue of higher quality. Such differences in quality, as well as differences in the composition of the issue, create another possible element of conservatism in this estimate.

b. Dollar Values

Dollar valuation of Soviet expenditures for military clothing (regular issue) presents the same situation as pertained for subsistence, and for largely the same reasons. The same alternative means may be used, although efforts to date have been limited to a determination of US outlays per capita for clothing and application of the figure so determined to Soviet military personnel. Again, such a figure is obtained by a combination of the outlays specifically labeled as being for clothing and the allowances paid to officers and enlisted men for initial issues and maintenance.* The same problems are applicable here too, among them the possible ambiguity of direct expenditures for clothing and the divergence in the composition (rank and grade structure) of the US and Soviet armed forces in any year.

c. Ruble-Dollar Ratios

It follows from the preceding discussion of dollar valuation that the possible ruble-dollar ratios may also be on two bases. At this juncture, however, only one ratio may be derived, and that ratio is no more than the relationship between US expenditures per capita in dollars and like expenditures in the USSR in rubles. The ratio so obtained is 4.4 rubles to US \$1, in terms of 1955 relationships.

d. Further Considerations

The requirements for data in this area are comprehensive. They range from price data and monetary allowances to the composition of the various issues of clothing.

For ruble expressions of Soviet outlays for clothing the following is needed: (a) the current basic clothing issue and such changes in the issue as have occurred since 1947; (b) other issues and the respective recipients; (c) more information on the prices paid by the Soviet military establishment and on how these prices have changed during 1948-60; and (d) any monetary allowances paid by the Soviet Ministry of Defense instead of, or as a supplement to, issues of clothing.

3. Subsistence (Food) for Militarized Security Forces

The values per capita employed for the regular armed services** are used for the security forces.

4. Clothing for Militarized Security Forces

The available evidence indicates that militarized security personnel receive essentially the same issue of clothing as personnel of the Soviet army, naval, and air forces.***

* A figure of \$200 per man per year has been employed in terms of 1955 relationships.

** See 1, above.

*** See 2, above.

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5. Subsistence (Food) for Reservists on Temporary Active Duty

The Soviet Ministry of Defense is presumed to bear the expense of feeding reservists on these abbreviated tours of duty. Accordingly, the calculated per capita cost of rations for the active regular service personnel has been extended to cover like expenditures for reservists.

6. Clothing for Reservists on Temporary Active Duty

No outlays for issues of clothing to reservists have been incorporated in these analyses of Soviet military expenditures. Admittedly it seems unrealistic that the Ministry of Defense bears no expense of this kind, but, given the number of reservists and their abbreviated tours of duty, it seems highly unlikely that they receive anything but the temporary use of used clothing. Thus the associated expenditures would be relatively slight.

7. Other Facilities

This category of construction is a catchall intended to represent all military facilities not specifically included in other accounts. It falls somewhat short, however, and is limited to administration buildings, warehouses, hospitals, and petroleum storage facilities. To the extent that some of these are included in other accounts they are treated here on a net basis. Because of the similarity in the means of building the estimates for three of the four items, they are all treated together.

a. Ruble Values

Annual expenditures for military administration buildings and warehouses are computed in the same way as those for barracks. The only variant is the price per square meter of structure.* It is assumed that 1 square meter per man of each of these types of structure would satisfy the minimum requirements of the Soviet forces. For this purpose, a constant force level of 4 million men is posited for the period beginning with 1947. The requirement of 4 million square meters of each of these types of facility is estimated to have been fulfilled in 1955. Annual expenditures for new construction are the same function of the value of the base year inventory as is the case for barracks.**

Expenditures for hospitals are treated in similar fashion: a basic inventory in 1955 and the same converging series of outlays for replacement and maintenance. The sole difference is that the requirements for space per man are converted to the cost per bed, 35,000 rubles in 1955 prices. Soviet data on civilian hospitals serve as a guide for this value and also provide some indication as to the number of beds to be expected in military hospitals. It has been concluded that in 1955, when the inventory requirement was reached, the available beds were sufficient to accommodate 1 percent of the personnel of the forces. Again, the figure of 4 million men is used for this purpose as the representation of manpower.

Storage facilities for petroleum, oil, and lubricants are treated in a different manner. It is posited that storage facilities with a capacity equal to 20 percent of annual consumption is the rule for all Soviet forces.

* In 1955 prices, 1,000 rubles per square meter for administration buildings and 580 rubles per square meter for warehouses.

** Ten percent of the value of the inventory as estimated for 1955 is taken to represent the annual expenditures for new construction and maintenance. In 1947 expenditures equal to $7\frac{1}{2}$ percent of the value of the inventory are estimated to have been allocated for replacement, $2\frac{1}{2}$ percent for maintenance. It is presumed that both types of expenditure converged over time on a limit of 5 percent of the value of the inventory, and that this limit is reached in 1955.

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Thus a basic inventory for 1947 is computed, and annual increments to this inventory are calculated as a direct function of the increases in consumption of petroleum products. The resulting series is then smoothed; that is, the average outlays during the periods 1947-50, 1951-55, and 1956 on are used as the annual values during the respective periods. Irregularities in the unsmoothed series are inconsistent with what was to be expected from other related developments. It is necessary to employ US prices for these facilities* and to convert the resulting values with the ruble-dollar ratio for construction.

In this instance, there is an element of double counting, so small it can be ignored, which stems from the inclusion of storage facilities for petroleum products in the calculations of expenditures for the construction of air bases and the all-inclusiveness of this method of computing storage facilities.

b. Dollar Values

Dollar equivalents are obtained in exactly the same fashion as for the facilities already discussed. Where direct valuation is in rubles, as in expenditures for administration buildings, warehouses, and hospitals, the ruble-dollar ratio for construction is applied. In the case of storage facilities for petroleum products, direct valuation is in dollars.

c. Ruble-Dollar Ratios

The same ratio of 6.4 rubles to US\$1 in 1955 prices is employed.

d. Further Considerations

The emphasis must be placed on the need for more specific information on the exact types and quantities of those facilities that the Soviet military establishment has and the rates of accretion during a period of time. Least is known about the facilities to be found at ground force and logistical installations in the USSR. As already noted, all facilities are not accounted for, and information which would permit extension of these estimates is desirable.

8. Maintenance of Facilities

a. Ruble Values

Estimates of the outlays made by the USSR to maintain its military facilities are directly related to the outlays initially required to construct them. Annual maintenance outlays generally are determined at 5 percent of the value of the facilities.** This factor is no more than a representation of what was deemed generally to be appropriate for items of construction in view of Soviet conditions -- for example, the severe weather. The facilities included in this estimate are air installations; missile sites; naval bases; petroleum storage facilities; buildings of fixed installations for communications; barracks; hospitals; and buildings for administration, storage, and other purposes.

b. Dollar Values

Dollar equivalents are obtained by applying the ruble-dollar ratio for construction.

c. Ruble-Dollar Ratios

A single ruble-dollar ratio of 6.4 rubles to US \$1 in terms of 1955 relationships is employed to obtain dollar equivalents. This ratio is designed to be applicable to the Soviet construction activity in general, but the little evidence available that deals directly with military construction suggests that it is reasonable for military construction as well. This ratio, however, is probably conservative for maintenance as defined -- that is, exclusive of labor -- because construction materials are relatively more costly in the USSR than in construction.

* The minimum prices used for computing the storage capacity of air bases are employed.

** It will be noted that this factor is exclusive of the value of military and civilian labor of the Ministry of Defense in maintaining facilities. Personnel costs are not included.

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d. Further Considerations

Actual outlays and the prices paid by the Soviet Ministry of Defense for this type of activity and the maintenance schedules and/or planning factors used constitute the information for which there is the most pressing need.

9. Petroleum Products*

a. Ruble Values

Most of the Soviet military consumption of petroleum products, including that for operating and maintaining equipment, is represented by the estimates under this entry. Operating reserves, which are probably paid for by the Ministry of Defense, and stockpiles, which are believed not to be paid for by the ministry, are excluded. Expenditures for operating reserves are likely to be nonrecurring -- that is, for a given type and quantity of equipment, once these reserves are on hand they need not be considered further as an element adding to cost. As the composition and number of units change and/or new equipment is introduced, however, these reserves will change with regard to volume and product.

Estimates, in metric tons, are available for the consumption of the various petroleum products by each of the Soviet services.** These estimates are derived by applying factors computed for each type of equipment or category of personnel to estimates of the order of battle.***

The resulting consumption, in tons, is then apportioned to zones in the USSR and European Satellites in accordance with the geographic distribution of Soviet troops and equipment. The application of internal zonal wholesale prices† for the various petroleum products yields the ruble valuations of the expenditures required for this consumption. For the Soviet prices in 1955, see Table 2.†† Similar information is available in terms of prices on 1 July 1950.†††

b. Dollar Values

Equivalent dollar valuations are obtained by applying a ruble-dollar ratio.

c. Ruble-Dollar Ratio

For simplicity and ease of handling, a single ratio of 13.4 rubles to US \$1,‡ in terms of 1955 relationships, is applied to the summation of the ruble valuations described above. Actually the ratios for consumption by naval and ground forces should be slightly higher, that for consumption by the air forces slightly lower. These differences, however, amount to no more than several tenths of a ruble per dollar, hardly enough to introduce any distortion in the results. Future presentation, however, may well require differentiation not only among the armed services, but perhaps to the extent of separate treatment for each principal petroleum product. Such differentiation will present no problem.

d. Further Considerations

Price data are for the most part plentiful. The major problem is establishing whether the available Soviet prices truly represent the prices paid

* Expenditures for solid fuels and purchased electric power are partially covered under another account. Such expenditures, in aggregate, are believed to be rather small.

** Published reports 17/ provide estimates for part of the historical period. These estimates have been projected to complete the requisite series.

*** No allowance is made for Air Force and Army requirements for petroleum products for such purposes as space heating and lighting; they are considered to be insignificant. Handling losses are taken into account for aviation fuel and lubricating oil.

† The turnover tax and transportation charges are included.

†† Table 2 follows on p. 9.

††† 1955 prices (1 July) are 23 percent lower than those of 1 July 1950.

‡ Based on Soviet weights to which ruble and dollar prices were applied.

Table 2

Prices of Selected Petroleum Products in the USSR a/
1 July 1955

Product	Rubles per Metric Ton				
	Zone				
	I	II	III	IV	V
Automotive gasoline					
A-66	537	564	594	640	704
A-70	620	670	720	790	880
A-74	715	745	785	875	960
Aviation gasoline					
B 100/130	1,025	1,075	1,100	1,140	1,315
B 95/130	898	945	896	1,088	1,238
B 93/130	875	915	960	1,060	1,200
B 91/115	715	745	785	875	960
Jet fuel					
T-1, TS-1, T-2	370	390	415	440	448
Light diesel fuel					
L	292	317	324	350	420
L	312	337	344	370	440
DL	292	317	324	350	420
Lubricants					
Auto-tractor oil AK-15 (Artol 18)	740	780	830	900	1,000
AK-10 (Artol 10)	810	850	900	970	1,070
AKZ p-6 and p-10	1,050	1,100	1,150	1,220	1,320
Diesel oil D-11, Dp-8, Dp-11, Dp-14 (with additive AN 11 Tsistin-1, except for D-11)	908	972	1,032	1,088	1,188
Diesel oil Dp-8, Dp-11, Dp-14 (with additive Tsistin-339)	1,028	1,272	1,332	1,388	1,488
Automobile transmission oil	332	368	416	490	590
Auto-tractor transmission oil					
Summer grade	300	340	385	460	560
Winter grade	332	368	414	490	590
Aviation lubricants	1,000	1,040	1,100	1,170	1,280
Fleet mazut	250	279	295	320	388

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by their military establishment. The current belief is that they do -- that is the Ministry of Defense pays the turnover tax. A second problem and one of lesser concern is the need for additional price information for years between major price changes. Adequate detail exists with regard to prices of 1 July 1950 and 1 July 1955; information on price movements in the interim period and since 1955 is sketchy. Because the biggest part of the studies of Soviet military expenditures are conducted in base year prices not having detailed information for interim periods is not of great importance. For purposes of refined budgetary analysis which is conducted in current terms suitable information on price movements becomes essential.

10. Research and Development

It is clear that the interest in research and development, insofar as this report is concerned, is confined to that research and development having a more or less direct bearing on Soviet military capabilities. The available data, however, preclude making a direct approach to estimating this particular aspect of Soviet research and development. Instead, it has been necessary to consider all such activity and only thereafter to estimate the military share.

a. Ruble Values

Although the USSR reveals sizable expenditures for science, not enough additional data are available to permit direct estimation of total expenditures for research and development. Therefore, analogy must be resorted to.

The rather regularly announced expenditures for "financing scientific research establishments," which are financed primarily from the budgetary allocation for social-cultural purposes, appear to correspond to what would ordinarily be termed research and development in the US.* The rest of the Soviet program, which is hereafter referred to as product development, is closely akin to the concept of development, test, and evaluation used by the US Department of Defense.

On the basis of this kind of division of expenditures for research and development in the US, specifically by the Department of Defense, a relationship has been derived that is used for the USSR. In recent years, expenditures of the US Department of Defense for development, test, and evaluation have been at least as great as those for research and development.** Because of the obviously heavy emphasis on military research and development in the USSR and because product development in general would reasonably be expected to receive more emphasis in the USSR than in the US,*** the use of a one-to-one relationship between product development and other research and development for the USSR appears to be justified but conservative. It is not possible to overcome the conservative bias, however, because no means was available for determining how much greater product development should be or how such a relationship would vary over time. Hence the one-to-one relationship is adopted as the best to be had at this time.

* Basic and applied research and its application to new uses up to the point of design and production engineering.

** Until the publication of the budget for 1960, expenditures for development, test, and evaluation were always included under procurement. In the budget for 1960, some of these expenditures have been combined with the expenditures for research and development under the entry Research, Development, Test, and Evaluation.

*** It seems credible that because so much of what has been developed in the West is available to the USSR and because the USSR is generally behind the West, there must be appreciable Soviet effort to adapt Western developments (that is, product development). This ability to progress, up to a point, without research should mean greater proportional emphasis on product development by the USSR.

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Recently one small element of support for this relationship has become available. Manpower figures reveal that the number of professional scientific personnel engaged in this activity is roughly the same as the number in other research and development. Although the latter might be expected to receive more in the way of remuneration, the activities of the former are likely to be more equipment intensive, thus providing a compensatory element.

Application of this relationship means that Soviet outlays for research and development are estimated at twice what were announced for "financing scientific research establishments." This procedure, within its limitations, is adequate for the period through 1957. In 1958, there was apparently a change in the scope of the announced expenditures for research and development.* No explanation can be documented, but the most reasonable hypothesis is that the economic reorganization that began in 1957 has included a considerable realignment in the subordination of the organizations engaged in research and development and that consequently some of the outlays for product development are now included in the announced allocation.

The procedure described so far encompasses the historical period but not the present and future. In arriving at estimates for the period beginning with 1958, personnel and wage data play an important part.

The nature of the data on scientific manpower, including their relative plenty and precision, makes them the most useful in attempting the projection. The series of scientific manpower employed in research institutions** has been selected for this purpose because the best direct data on expenditures are the announced allocations for financing these institutions. For the period 1950-57 the expenditure per scientist can then be determined and applied to the number of these scientists estimated for each of the following years. In accordance with the procedures used for the historical period, the expenditures so derived are doubled in order to take account of product development.

Constant ruble values are used to express these expenditures. The expenditures per scientist are derived initially in current rubles; they are converted to constant rubles by apportioning them between wages and other outlays*** and by applying a general index of wages ^{19/} and an index of industrial costs, respectively. In spite of obvious inadequacies the latter index is used to reflect changes in the prices of construction, equipment, and materials.

The resulting expenditures per scientist showed an annual average rate of increase of 2-1/2 percent in real terms over the period 1950-57. Although most of the increase took place during 1954-57, the average rate for the entire period is incorporated in the derivation of expenditures for 1958 and successive years.

* Apparently the announced plan for expenditures in 1958 was on the old basis and actual expenditures on the new basis. This difference may account for the indicated excess of actual expenditures compared with the plan. It is possible, however, that the figures would still show an excess of actual expenditures if both were given on the same basis. It is of interest that simple extrapolation of the budgeted funds announced for the period 1950-57 yields a value for 1959 that is remarkably close to the announced planned allocation of 23 billion rubles.

** Through 1957. Projections are based on estimates of more comprehensive groups of scientific personnel.

*** The changing relationship of wages to other outlays has been considered.

Only a partial test of the reasonableness of the expenditures per scientist is available. These expenditures include wages for supporting personnel as well as for the scientists. Application of estimated annual wages for such personnel indicates that about one-half of the estimated outlays go for wages. During the Fifth Five Year Plan it is estimated that roughly 70 percent of the expenditures of the Academy of Sciences were so expended, but the Academy has the highest paid scientific personnel. In addition, the nature of the Academy's work in pure and applied research would be expected to result in proportionally lower outlays for equipment and materials compared with other organizations engaged in research and development. Furthermore, US outlays for research and development seem to be apportioned roughly 50-50 between wages and other categories of expenditure. Although normally the mere fact of comparability between the US and the USSR in such an instance would be sufficient to arouse suspicion of the results, the relatively superior position of Soviet scientists in their wage structure compared with that of US scientists is a strongly mitigating circumstance. Moreover, statistics recently published by the USSR, although subject to alternate interpretation, are seemingly confirmatory. These statistics indicate a general decline, in the proportion represented by wages, from about 60 percent in 1950 to about 50 percent in 1957.* 20/

The final step, that of determining what proportion of total Soviet expenditures for research and development is of military significance, is rudimentary. Although it is known in general terms that Soviet research and development is oriented toward military ends and/or toward programs of likely military significance, to a lesser extent toward investment in heavy industry, and to a relatively negligible degree toward consumption, it is not possible to estimate specifically the relative shares. It has been postulated, therefore, that two-thirds of the total Soviet effort is for military or related purposes, in view of the fact that about one-half of US outlays for research and development (including product development) are within the scope of the Department of Defense and the Atomic Energy Commission and that the US expends a considerable amount on research and development for consumer goods. This proportion appears reasonable, but to date no evidence to support or disprove it has been found.**

Because of the possibility of amortizing the cost of such research and development and recovering it in price, the question of double counting arises with regard to this account. Regardless of this possibility, an underlying term for price information was that such information be exclusive of the costs of research and development. Where US prices have been used, they were to be free of nonrecurring costs, and fortuitously the Soviet prices generally pertain to items that had been in production for more than 2 years,*** that were being produced under license, or that were direct copies of Western products.

b. Dollar Values

In view of the limited amount of detail available, the dollar equivalent of Soviet expenditures in rubles for research and development is necessarily crude. As in all other instances in this report, dollar values conceptually represent the estimated outlays required to pay for the same programs and activities in the US. For research and development, as for military personnel, the principal expenditure is for manpower, not a commodity. Thus Soviet outlays for research and development when stated in dollars represent, in effect, what the manpower, materials, and the like used in the Soviet effort would cost in

* It should be noted that these published figures are in current rubles. In constant terms the changes would be magnified because wages have increased during the period, whereas other costs have, in general, declined.

** A declining proportion of the total of such expenditures was accounted for by the published breakdown 21/ of budgeted expenditures for financing scientific research establishments into wages and the like. In 1950, 57 percent of such expenditures were explained; in 1957, only 40 percent. Whether this failure to break down the residual is a reflection of sensitive Soviet programs is not known. In a sense, it seems to be too obvious a revelation for them to be making. Interestingly, the republic outlays are explained essentially in full; the unexplained expenditures involve disbursements from the union budget.

*** The usual practice, where amortization of research and development cost exists, is for that cost to be recovered during the first 2 years of series production.

CONCLUSION

the US; it does not represent what the final products of Soviet research and development would cost. Nor does it represent the cost to the USSR in real resources. In spite of the preferred position of scientists in Soviet society, the US scientists commands far more in real terms, and thus the application of US wage scales to Soviet personnel merely represents what the number of scientists would "cost" in the US.

The dollar equivalents are obtained by applying the ruble-dollar ratio discussed immediately below.

c. Ruble-Dollar Ratios

It is assumed that the apparently equal division of Soviet outlays for research and development (exclusive of product development) between wages and other items, is suitable for at least most of the period under study. With the use of this relationship, a ratio for manpower of 3 rubles to US \$1, and a ratio of other expenditures of between 6 and 10 rubles to US\$1, there are obtained over-all ratios of between 4 rubles and 5 rubles to US \$1 in 1955 terms. The upper limit of 5 rubles to US \$1 has been chosen largely because it is believed that the influence of product development would tend to raise the ratio.

Per capita outlays for scientists in the US and the USSR, when compared, present some interesting testimony. In 1953, US expenditures per scientist amounted to \$27,000 and Soviet expenditures to 110,000 rubles, a relationship of about 4 to 1. By 1955, Soviet outlays were increasing rapidly, as were those of the US, with the result that the relationship between ruble and dollar expenditures seemed to remain constant or perhaps to increase somewhat, to more than 4 to 1.

In spite of certain incomparabilities in the US and Soviet data, the per capita expenditures that are derived undoubtedly reflect an order of magnitude of reasonable proportions. Although ordinarily such comparison could not and should not be used to verify or to form the basis for a ruble-dollar ratio, in this instance, and given the apparent similarity in the use of the funds, it is not without relevance.

d. Further Considerations

It is not necessary to consider in detail the kind of information still necessary to improve considerably the estimates of Soviet research and development. In almost any aspect, additional information is needed -- for example, (a) Soviet expenditures for product development; (b) the number of each category of personnel employed in any phase of research and development; (c) outlays for wages, construction, equipment, and the like; (d) the distribution of funds with regard to research and development for military, industrial, and consumer purposes; and (e) more information on the financing of research and development.

11. Nuclear Energy

There are no data available that directly indicate the magnitude or composition of the expenditures for the Soviet nuclear energy program. Therefore, bills of materials have been developed for building and operating feed material plants, gaseous diffusion cascades, reactors, and other nuclear facilities required to produce the amounts of uranium and fissionable materials that the USSR is estimated to have produced. These bills of materials are based on what is known or can be inferred about Soviet plants and nuclear technology. US analogy is used only to fill the gaps left by incomplete knowledge of the Soviet program.*

* Estimates of Soviet expenditure for nuclear energy that were incorporated in past studies of military expenditures were based largely on analogy with such US expenditures.

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a. Ruble Values

The ruble values are determined either by pricing quantities of materials directly in rubles with prices available in Soviet catalogs or by converting dollar costs into ruble costs through the use of appropriate ruble-dollar ratios. The resulting estimates of Soviet expenditures for nuclear energy must be considered first approximations. These estimates are believed, however, to approximate reasonably the magnitude of the Soviet effort. It is believed that the cumulative estimates are more accurate than the estimates for individual years and that the estimates for the later years are more accurate than those for the earlier years.

b. Dollar Values

Dollar values are obtained directly. The dollar prices used are not based on estimates of cost of the same volume of production of fissionable materials in the US as is attributed to the USSR but rather are based on Soviet technology to the extent possible.

c. Ruble-Dollar Ratios

A series of ratios is employed. Many of these ratios had to be developed specially for this purpose by price comparisons of similar but not identical items of equipment.

d. Further Considerations

The degree of confidence in these estimates would be improved considerably with more precise information on the exact types of equipment and processes used in the various nuclear energy plants in the USSR and with Soviet prices for the special types of equipment used.

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SOURCE REFERENCES

Evaluations, following the classification entry and designated "Eval.," have the following significance:

<u>Source of Information</u>	<u>Information</u>
Doc. - Documentary	1 - Confirmed by other sources
A - Completely reliable	2 - Probably true
B - Usually reliable	3 - Possibly true
C - Fairly reliable	4 - Doubtful
D - Not usually reliable	5 - Probably false
E - Not reliable	6 - Cannot be judged
F - Cannot be judged	

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

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